Introduction to Analogical Reasoning

In this course, you will learn how to reason using analogies; that is you will compare different things to see what is similar and different about them, helping you have a better understanding of the domains being compared. Reasoning with analogies is something we all do everyday, but in this course we will focus on becoming rigorous in how to use analogies in learning about the principles underlying climate change.

This exercise will explain in detail what it means to reason via analogy. By giving easy to understand examples, it will be clear how to apply these methods to the topics of this course in the coming weeks. Going through this introduction, the answers may seem very obvious, but pay attention to what you are doing because using these techniques with the much less familiar and much more complicated topics of the course will be more difficult, so it is important you understand how to do this.

**Identifying the Common Relation**

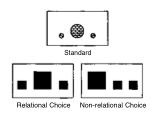
You all have experience with analogies from the SAT or ACT, however analogical reasoning goes well beyond those tests of vocabulary. Still, they demonstrate some key aspects of analogies. For example, consider

Bodyguard: Celebrity :: Force-Field: Spaceship

What makes something a sound analogy is when the relation between the two pairs of things is similar: Bodyguards *protect* celebrities, force-fields *protect* spaceships. It doesn’t matter that bodyguards and celebrities are not at all similar to force-fields and spaceships (the first two being humans, the second two not being humans, for example). What matters is that the relation between the first pair is the same as the relation between the second pair; in this case the common relation is *protection*.

There are many kinds of relations. It is illustrative of what it means to share a relation by considering these “visual analogies.”

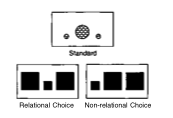
Figure 1.



In Figure 1, the top picture shows 3 shapes. Below there are two other sets of three shapes. The one on the left exhibits the same relation as the standard because the biggest shape is between the two smaller shapes.

Now consider Figure 2.

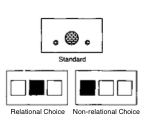
Figure 2.



Again the choice on the left is the relational match to the standard. It’s not as simple as the “biggest one is in the middle”, now it’s the common relation is that the one of a unique size is in the middle.

Consider Figure 3.

Figure 3.



Here, size is no longer relevant; the matching relation is that the unique thing is in the middle.

One point here is that there is essentially an unbounded set of possible matching relations. Relations can always become more abstract. For example, what is common to these pair of sentences?

1. Walcorp divested itself of Acme Tires
2. Martha divorced George.

One way to find the common relation is just to think about what makes things similar. For example, what is similar about watering a plant and taking a dog for a walk?

**Identifying Common Roles**

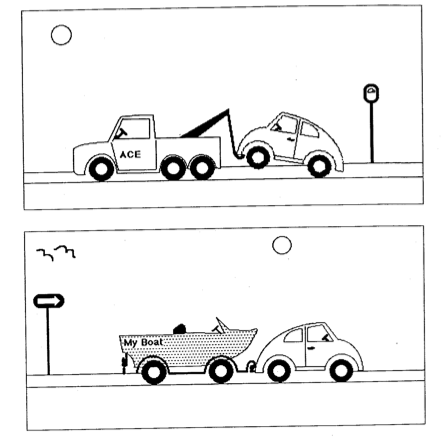
Again, consider this analogy

Bodyguard: Celebrity :: Force-Field: Spaceship

Recognizing that the same kind of relation holds between two pairs of things entails noticing that one object in each pair corresponds to one from the other pair because they play the same role in their respective pair. That is, bodyguards and force-fields are both *protectors* while celebrities and spaceships are both *protectees*. Placing very different things in correspondence based on the common role they play is a crucial aspect of analogical reasoning, one that this class will focus on. This process of recognizing common relations and role-based correspondences is called “alignment”

To demonstrate putting objects into correspondence by common role, consider Figure 4. What object in the bottom scene corresponds to the car in the top scene?

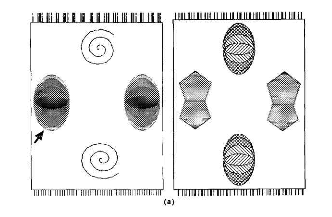
Figure 4



One might first think the other car because they are so similar, however, if, as during analogical comparison, one were to put objects into correspondence by role, the car in the top scene aligns with the boat in the bottom scene because each are the vehicles being towed. The car in the bottom scene corresponds to the truck in the top because each is towing the other vehicle.

This also works with visual spatial analogies. What object in the right picture of Figure 5 corresponds to object in the left image? If focusing on surface similarities, then it would appear to be one of the other circular objects, but in terms of spatial relations, it corresponds to the object on the left that is two conjoined pentagons.

Figure 5.



**Finding Differences**

Analogical comparison is great for finding similarities, but also for finding crucial differences. This may sound strange because it is intuitive to think that the more similar things are the fewer differences they have. However consider the following.

What are more similar a hotel and a motel, or a hotel and a coconut?

Now, what are some differences between a hotel and a motel?

What are the differences between a hotel and a coconut?

It is much easier to list differences between the first pair, even though they are much more similar.

Remember the analogy between a Walcorp’s divestment & Marth’s divorce. What’s different about a divestment and a divorce? What’s different about watering a plant and walking a dog?

**Generating Inferences**

Analogical reasoning starts with aligning two domains via comparison. A result of this alignment is generating inferences about one domain based on the other. For example, consider again this pair of sentences.

1. Walcorp divested itself of Acme Tires
2. Martha divorced George.

Now consider, and fill in the blank:

Walcorp then acquired a more lucrative subsidiary company.

Likewise, Martha \_\_\_\_\_\_\_\_

Consider again the analogy between walking a dog and watering a plant. Let’s say you were explaining how to water a plant to a child who knew about walking dogs. You might say: “If you walk the dog for too long, she will get overtired. Likewise\_\_\_\_\_\_\_”

**Alignment, Inferences & Differences with Richer Domains**

Next, to demonstrate aligning more rich yet familiar domains, we will draw an analogy between baseball and hockey. We will put elements of each into correspondence by common role. Then, generate inferences about one based on the other, and finally find important differences between the two.

Before putting aspects of each into correspondence, identify the role that elements from each domain play. In Table 1, identify each object/person’s roles for baseball, and Table 2, identify each for hockey.

Table 1. Baseball

|  |  |
| --- | --- |
| Baseball | Role |
| Pitcher |  |
| Ball |  |
| Home plate |  |
| Umpire |  |
| Bat |  |
| Park |  |

Table 2. Hockey

|  |  |
| --- | --- |
| Hockey | Role |
| Puck |  |
| Goal |  |
| Referee |  |
| Goalie |  |
| Rink |  |
| Stick |  |

In Table 3, use the objects’ and people’s common role to put pairs into correspondence.

|  |  |  |
| --- | --- | --- |
| Baseball | Hockey | Common Role |
| Pitcher |  |  |
| Ball |  |  |
| Home plate |  |  |
| Umpire |  |  |
| Bat |  |  |
| Park |  |  |

**Making Inferences**

The analogical inferences that are the most sound to make are based on the correspondences. For example, often in hockey, the best team with the best regular season record doesn’t win the championship, it is the team with the goalie who is playing the best during the post-season. Based on this, in baseball, what single position might be able to bring the rest of an overall inferior team past a better one in a post-season series, pitcher or left-fielder?

Again, in this case, the inference is obvious. However, in many science domains, it is this very kind of inference about much less understood topics that leads to important new discoveries

**Finding Important Differences**

Again, analogical comparison entails putting pairs of elements into correspondence, and one result of this is noticing key differences between the domains. For example, while the pitcher and the goalie are both the most important defensive player, and the goal and home plate are both critical in scoring, what is different about how one uses the goal and home plate to score, and what is different about how the pitcher and the goalie prevent scoring?

**Final Note**

In Science, analogies are not just about alignment based on any kind of relation or role, but specifically based on *causal* relations, principles and roles. Throughout the rest of the course, the methods just used to draw an analogy between baseball and hockey will be used on course content, however instead of alignment on just a common role, the alignment will be based on when the same causal principle explains two aspects of the domains being compared.